CLAIMS

1. An electrode substrate, comprising:

a base material;

a metal circuit layer that is provided on the base material; and

a transparent conductive layer that is electrically connected to the metal circuit layer,

wherein the metal circuit layer is covered by an insulating layer.

2. The electrode substrate according to claim 1, wherein the insulating layer comprises a material that includes a glass component.

3. The electrode substrate according to claim 2, wherein the insulating layer is formed by printing a paste that contains glass frit.

4. The electrode substrate according to claim 1, wherein the metal circuit layer is formed by using a printing method.

5. A photoelectric conversion element, comprising:

the electrode substrate according to claim 1;

a counter electrode that is placed facing a side of the electrode substrate above which the transparent conductive layer side is provided; and

an electrolyte layer or charge transfer layer that is provided between the counter electrode and the electrode substrate.

6. A dye-sensitized solar cell comprising:

the electrode substrate according to claim 1;

a semiconductor porous film that is provided on a side of the electrode substrate above which the transparent conductive layer side is provided;

a sensitizing dye that is provided on a surface of the semiconductor porous film;

a counter electrode that is placed facing the semiconductor porous film; and

an electrolyte layer or charge transfer layer that is provided between the counter electrode and the electrode substrate above which the semiconductor porous film is formed.

7. An electrode substrate comprising:

a transparent substrate;

a metal circuit layer that is provided on the transparent substrate; and

a transparent conductive layer,

wherein the metal circuit layer comprises at least two layers, the at least two layers comprising:

an inner layer; and

an outer layer.

8. The electrode substrate according to claim 7, wherein the outer layer is formed using a printing method.

9. The electrode substrate according to claim 7, wherein a volume resistivity of the inner layer is smaller than a volume resistivity of the outer layer.

10. The electrode substrate according to claim 7, wherein the outer layer is formed using a paste composition that contains at least conductive particles and a binder material, and a compounding ratio of binder material in the paste composition is greater than the compounding ratio of a binder material in compositions that is used for other layers in the metal circuit layer.

11. The electrode substrate according to claim 7, wherein the composition that is used to form the metal circuit layer contains at least one of silver and nickel.

12. The electrode substrate according to claim 7, wherein a shielding layer is provided on a surface of a conductive layer, the conductive layer comprising:

at least one of the metal circuit layer and the transparent conductive layer.

13. A photoelectric conversion element, comprising:

the electrode substrate according to claim 7;

a counter electrode that is placed facing a side of the electrode substrate above which the transparent conductive layer side is provided; and

an electrolyte layer or charge transfer layer that is provided between the counter electrode and the electrode substrate.

14. An electrode substrate comprising:

a transparent substrate;

a metal circuit layer that is provided on the transparent substrate; and

a transparent conductive layer,

wherein the metal circuit layer is formed according to grooves corresponding to a wiring pattern defined in the transparent substrate, and at least a portion of the metal circuit layer is received inside the grooves.

15. The electrode substrate according to claim 14, wherein at least a surface of the metal circuit layer is covered by a shielding layer.

16. The electrode substrate according to claim 15, wherein the shielding layer contains at least one selected from the group consisting of a glass component, a metal oxide component, and an electrochemically inert resin component.

17. A photoelectric conversion element, comprising:

the electrode substrate according to claim 14;

a counter electrode that is placed facing a side of the electrode substrate above which the transparent conductive layer side is provided; and

an electrolyte layer or charge transfer layer that is provided between the counter electrode and the electrode substrate.

18. A conductive glass substrate for use in a photoelectric conversion element comprising:

a glass plate;

a transparent conductive film that is formed on the glass plate;

a conductive circuit layer that is provided so as to be conductive with the transparent conductive layer; and

an insulating circuit protective layer that is formed on the conductive circuit

layer,

wherein a metal that easily form a passive state is provided in pinhole portions that are present in the circuit protective layer.

19. The conductive glass substrate for use in a photoelectric conversion element according to claim 18, wherein the conductive circuit layer contains at least one of a catalyst metal having a catalyst action with a metal that easily form a passive state, or a substituent metal to be substituted with the metal that easily form a passive state during plating the metal that easily form a passive state.

20. The conductive glass substrate for use in a photoelectric conversion element according to claim 18, wherein an opening area ratio of the conductive circuit layer is 75% or more.

21. The conductive glass substrate for use in a photoelectric conversion element according to claim 18, wherein the conductive circuit layer contains at least one metal selected from the group consisting of gold, silver, platinum, palladium, copper, and aluminum.

22. The conductive glass substrate for use in a photoelectric conversion element according to claim 18, wherein the insulating circuit protective layer is formed using an insulating paste material.

23. The conductive glass substrate for use in a photoelectric conversion element according to claim 18, wherein the metal that easily form a passive state is formed by an

electroless metal plating process.

24. The conductive glass substrate for use in a photoelectric conversion element according to claim 23, wherein the electroless metal plating process is electroless nickel plating, electroless cobalt plating, or electroless tin plating.

25. A dye-sensitized solar cell comprising:

the conductive glass substrate according to claim 18;

a semiconductor porous film that is provided on a side of the electrode substrate above which the transparent conductive layer side is provided;

a sensitizing dye that is provided on a surface of the semiconductor porous film;

a counter electrode that is placed facing the semiconductor porous film; and

an electrolyte layer or charge transfer layer that is provided between the counter electrode and the electrode substrate above which the semiconductor porous film is formed.

26. A method for manufacturing a conductive glass substrate for use in a photoelectric conversion element comprising the steps of:

forming a transparent conductive layer on a surface of a glass plate;

forming a conductive circuit layer on the transparent conductive layer by plating or screen printing using a material that contains at least one of a catalyst metal having a catalyst action with a metal that easily form a passive state, or a substituent metal to be substituted with the metal that easily form a passive state during plating the metal that easily form a passive state;

forming a circuit protective layer on the conductive circuit layer using an

insulating paste; and

filling pinholes that are generated in the circuit protective layer in the an electroless metal plating process of nickel, cobalt, or tin using a metal that easily form a passive state.

27. An electrode substrate comprising:

a base material;

a metal circuit layer that is provided on the base material; and

a transparent conductive layer that is electrically connected to the metal circuit layer,

wherein the metal circuit layer is covered and insulated by an insulating layer that includes a heat-resistant ceramic as a main component.

28. The electrode substrate according to claim 27, wherein the heat-resistant ceramic contains at least one of alumina, zirconia, and silica.

29. The electrode substrate according to claim 27, wherein the insulating layer contains at least one of silicate, phosphate, colloidal silica, alkyl silicate, and metal alkoxide.

30. The electrode substrate according to claim 27, wherein the insulating layer is formed using a printing method.

31. The electrode substrate according to claim 27, wherein the metal circuit layer is formed using a printing method.

32. The electrode substrate according to claim 27, wherein at least a portion of the metal circuit layer is received within a concave portion that is defined in a surface of the base material.

33. A photoelectric conversion element, comprising:

the electrode substrate according to claim 27;

a counter electrode that is placed facing a side of the electrode substrate above which the transparent conductive layer side is provided; and

an electrolyte layer or charge transfer layer that is provided between the counter electrode and the electrode substrate.

34. A dye-sensitized solar cell comprising:

the electrode substrate according to claim 27;

a semiconductor porous film that is provided on a side of the electrode substrate above which the transparent conductive layer side is provided;

a sensitizing dye that is provided on a surface of the semiconductor porous film;

a counter electrode that is placed facing the semiconductor porous film; and

an electrolyte layer or charge transfer layer that is provided between the counter electrode and the electrode substrate above which the semiconductor porous film is formed.